Evaluating GPP at regional and global scales

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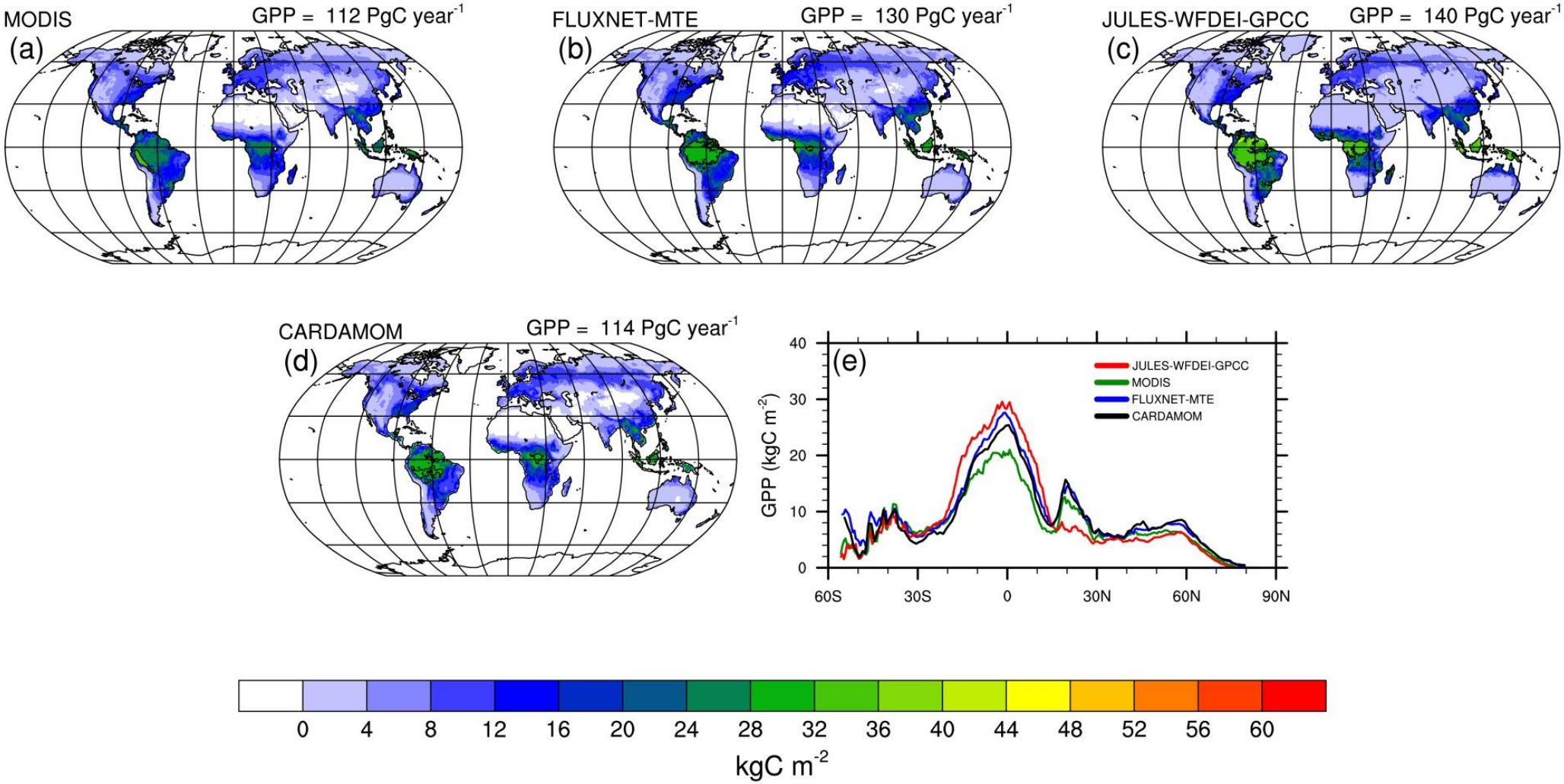
NATURAL ENVIRONMENT RESEARCH COUNCIL

Evaluating GPP at regional and global scales

- Evaluate the ability of the JULES (vn3.4.1) LSM to simulate GPP at regional and global scales for 2001-2010.
    - Various meteorological datasets (WFDEI-GPCC, WFDEI-CRU and PRINCETON) and spatial resolutions.
- Compared to **MODIS** (satellite), **FLUXNET-MTE** (machine-learning) and **CARDAMOM** (data assimilation framework) GPP.

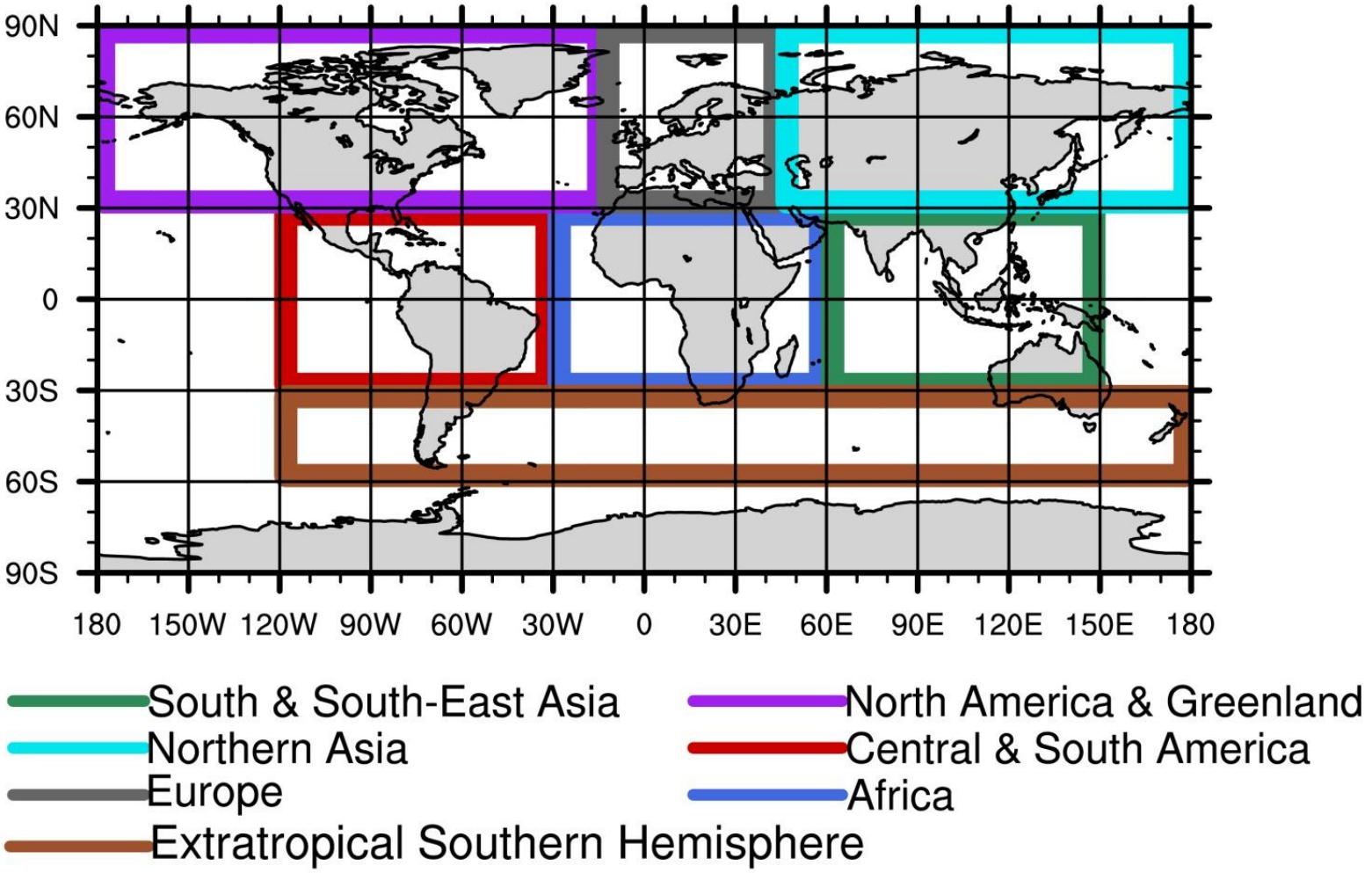
Global GPP



JULES simulates annual average global GPP of 140 PgC year^{-1} over 2001-2010 when driven with WFDEI-GPCC.

Greater than MODIS, FLUXNET-MTE and CARDAMOM estimates by 25%, 8% and 23% on average, respectively.

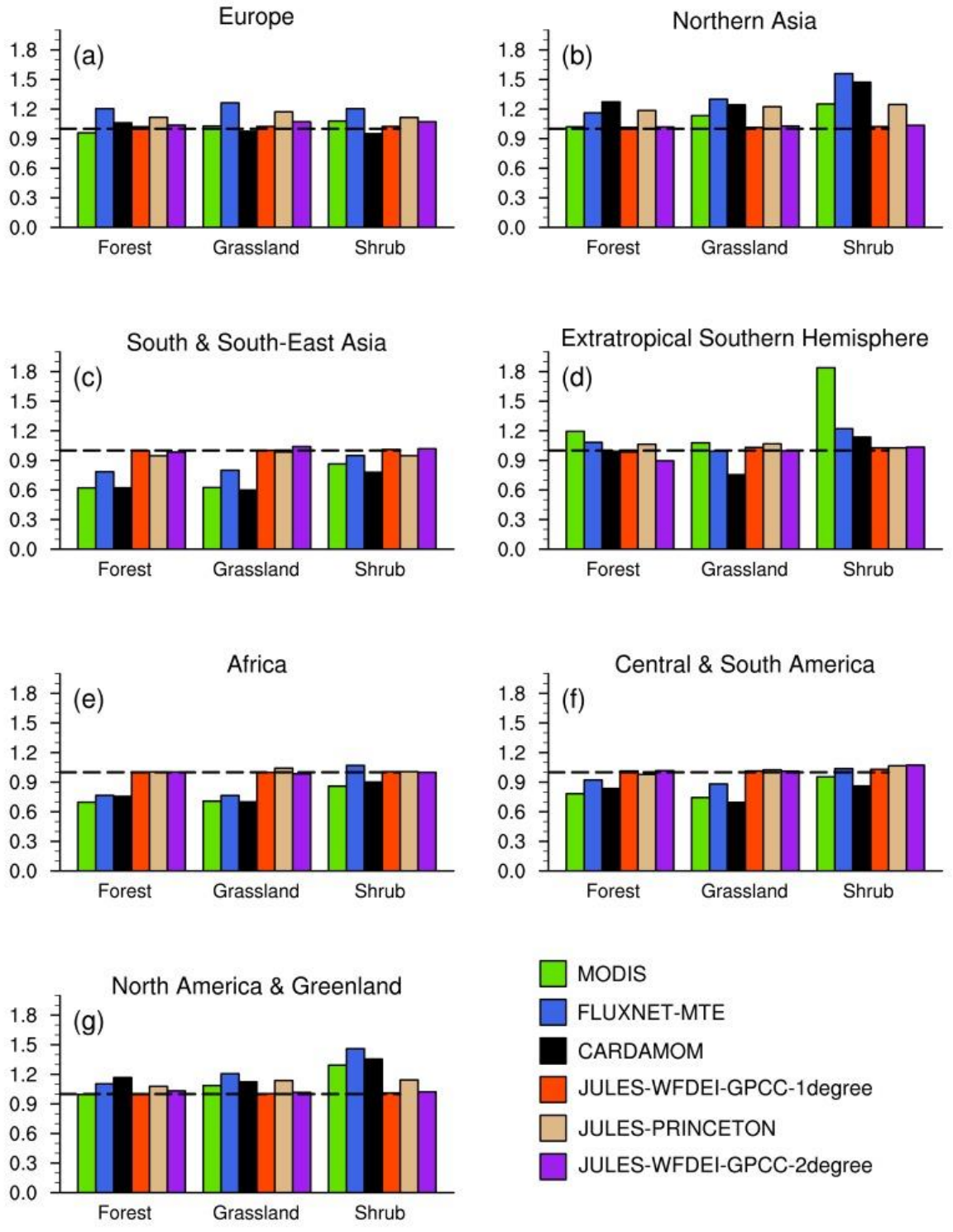
Regional comparison of simulated GPP for various biomes



GPP analysed at regional scales by dividing the global land area into seven regions (**4 extratropical and 3 tropical**) for various biomes (**forests, grasslands and shrubs**).

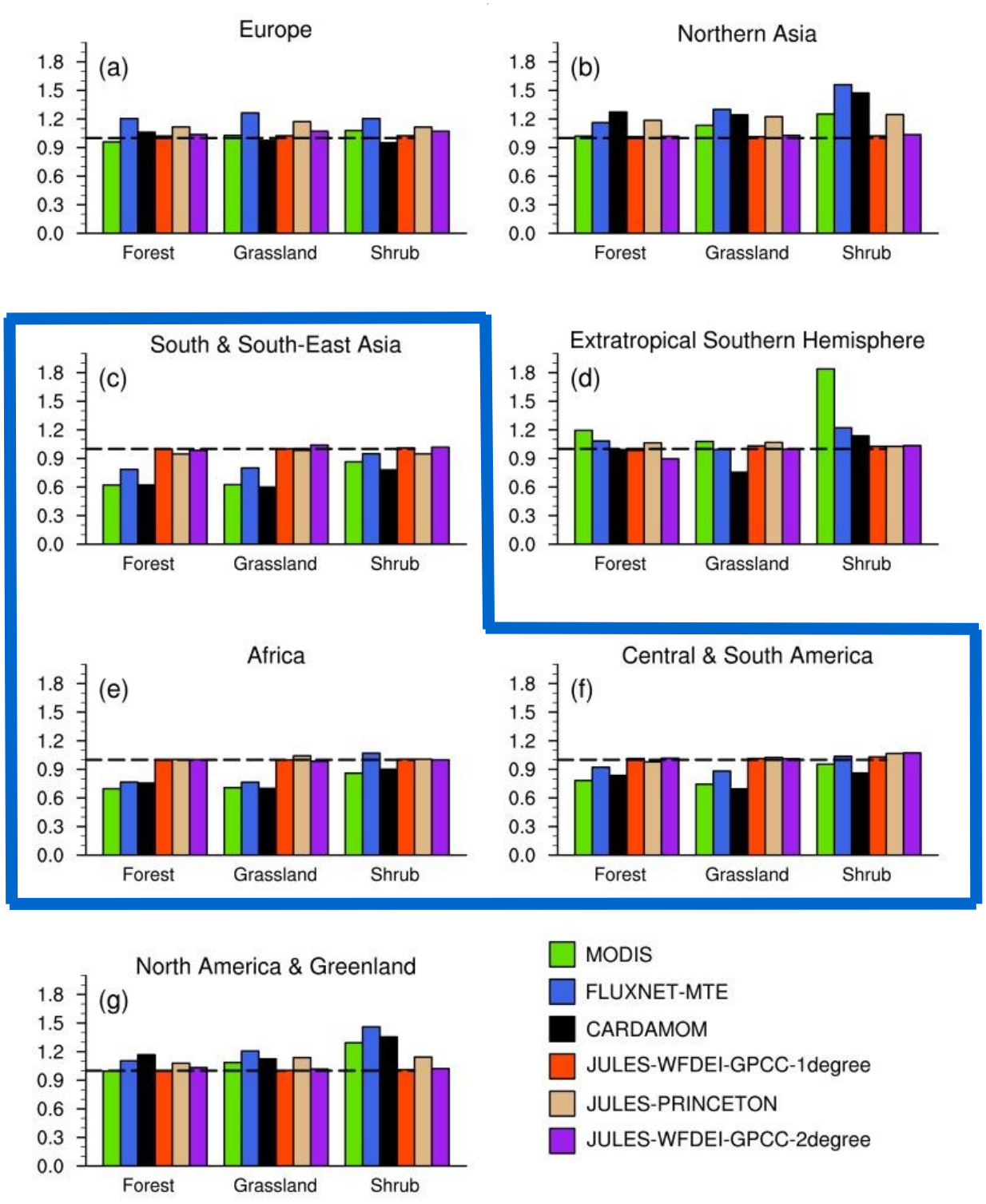
Regional comparison of simulated GPP for various biomes

The dotted line at y=1 represents where the model and observation-based estimates match.



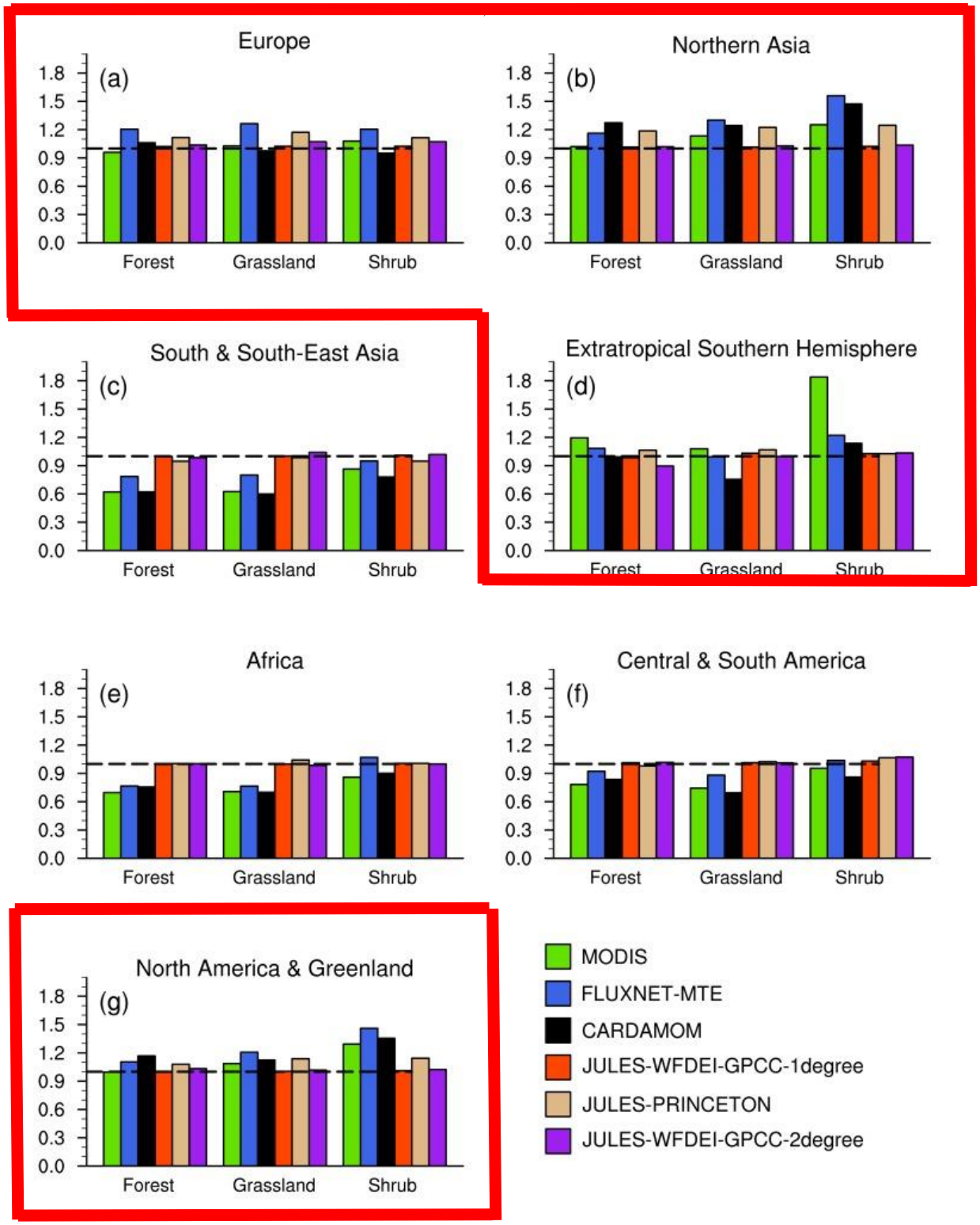
Regional comparison of simulated GPP for various biomes

JULES overestimates GPP in all 3 tropical land areas .

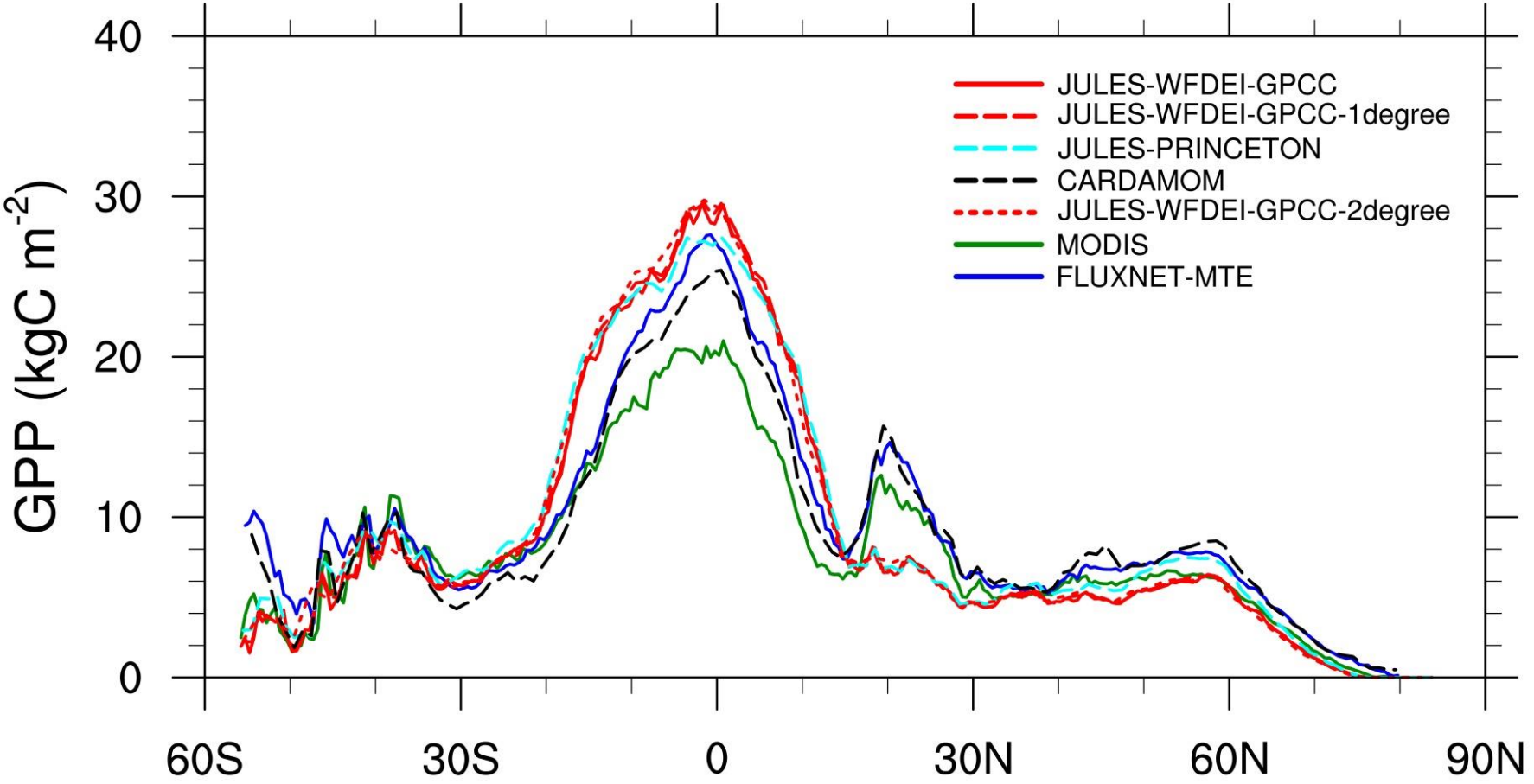


Regional comparison of simulated GPP for various biomes

JULES simulates GPP reasonably well in the extratropics.



Sensitivity to spatial resolution & meteorological dataset



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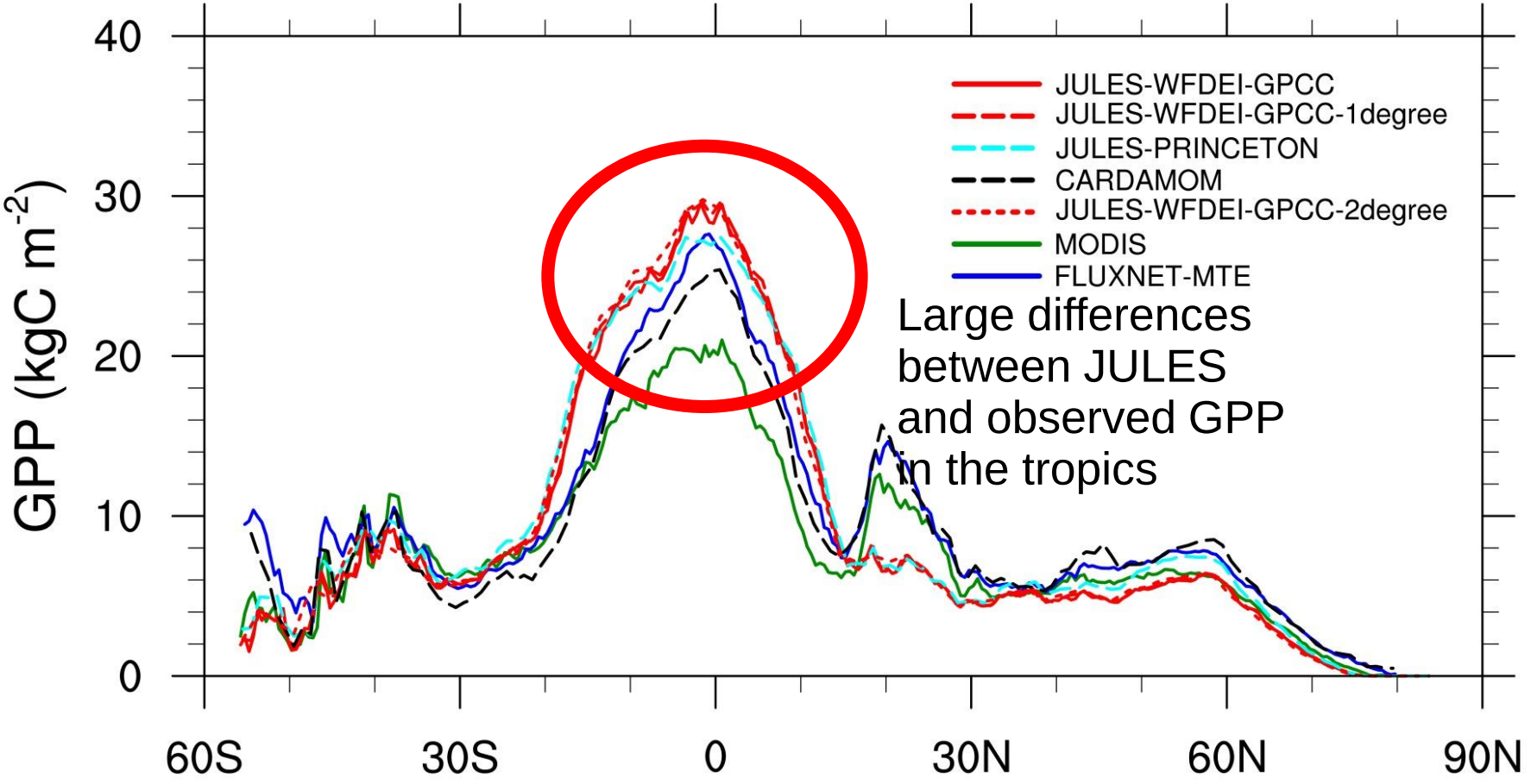
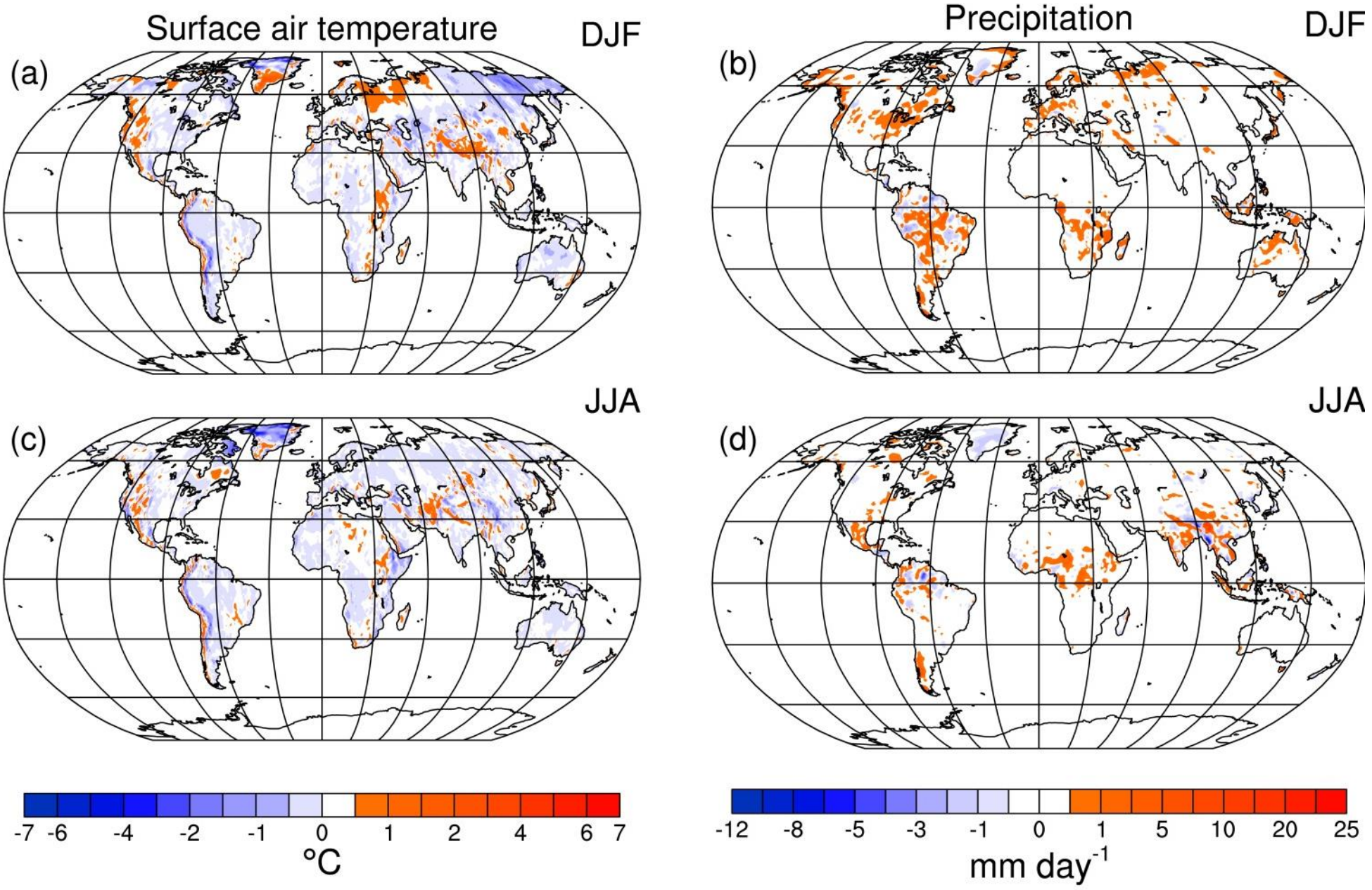
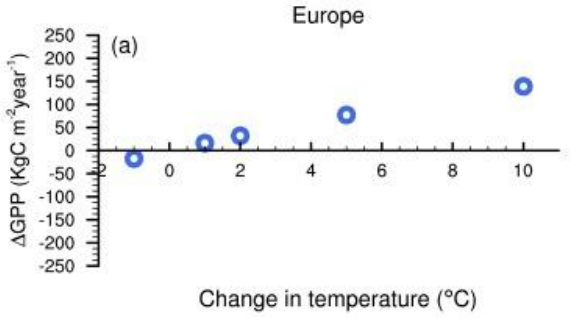


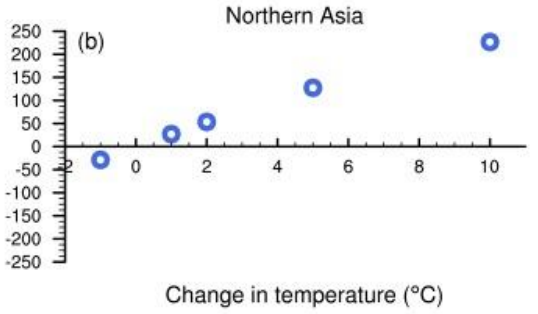


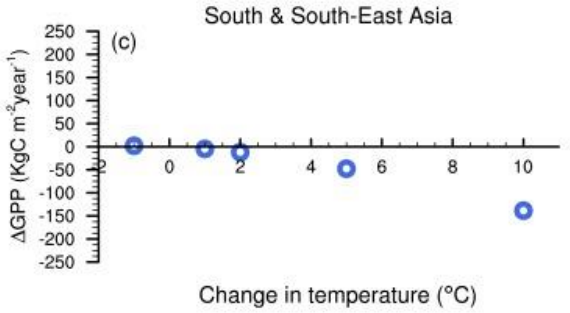
Blue = PRINCETON > WFDEI-GPCC, orange = opposite

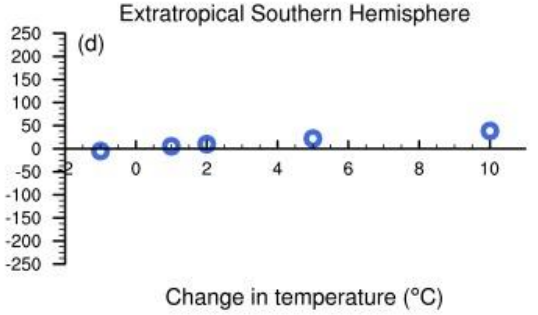
Lower surface air temperatures and higher precipitation in the WFDEI-GPCC dataset.

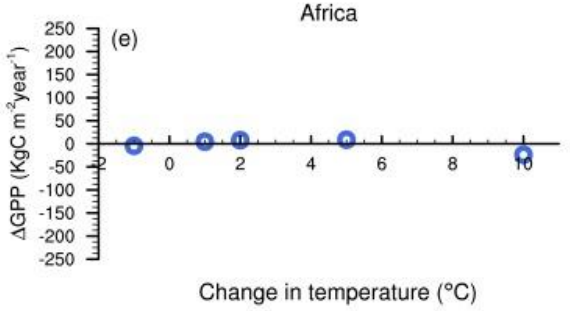
In the extratropics, JULES GPP (driven with the WFDEI-GPCC dataset) was found to increase with increases in surface air temperature and **in the tropics, GPP was found to decrease with increases in air temperature.**

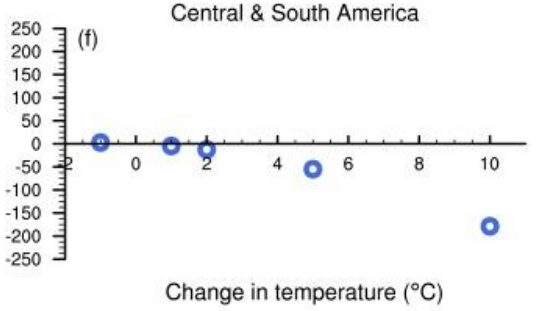


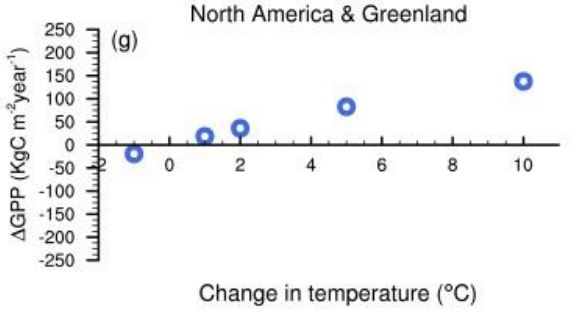












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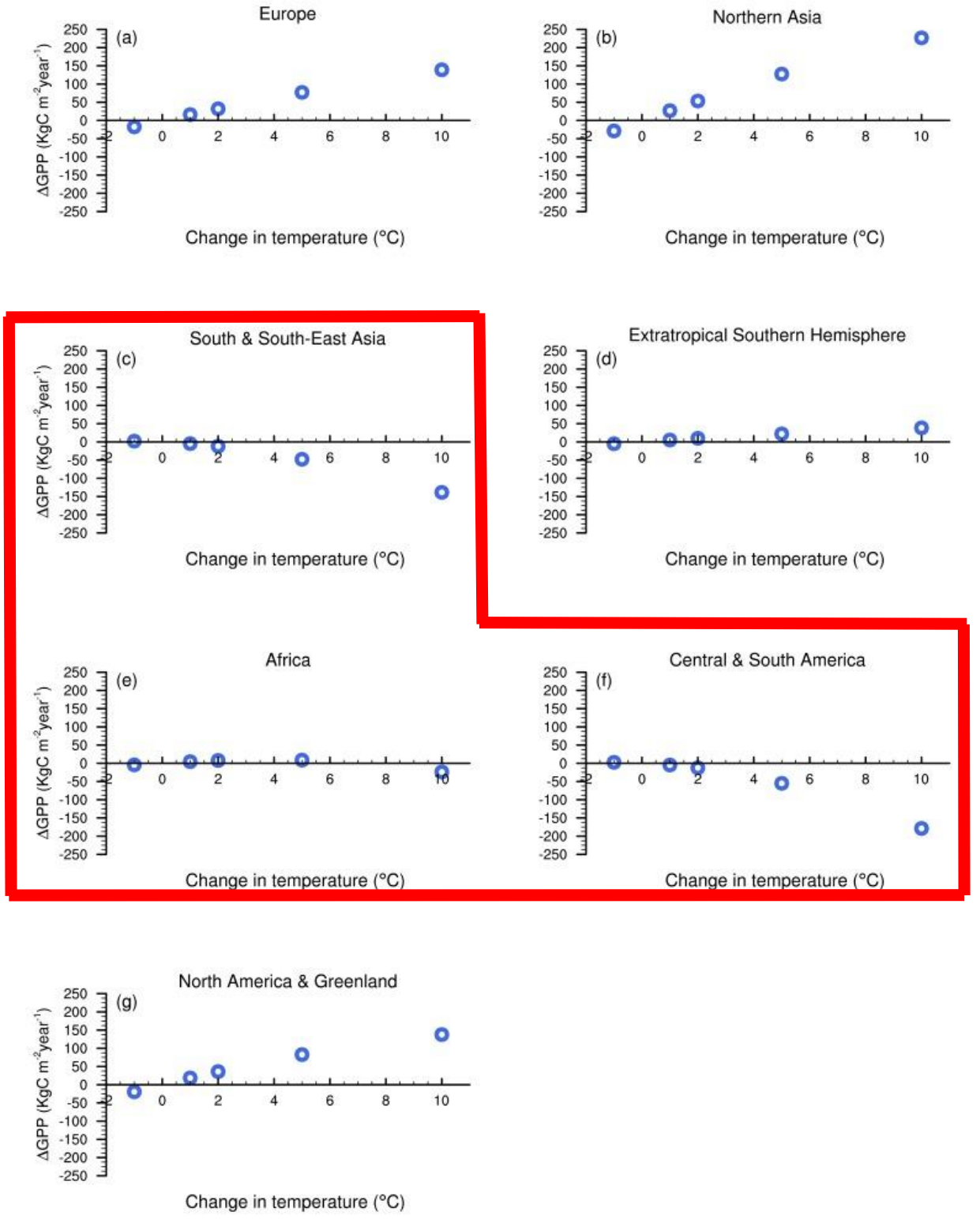
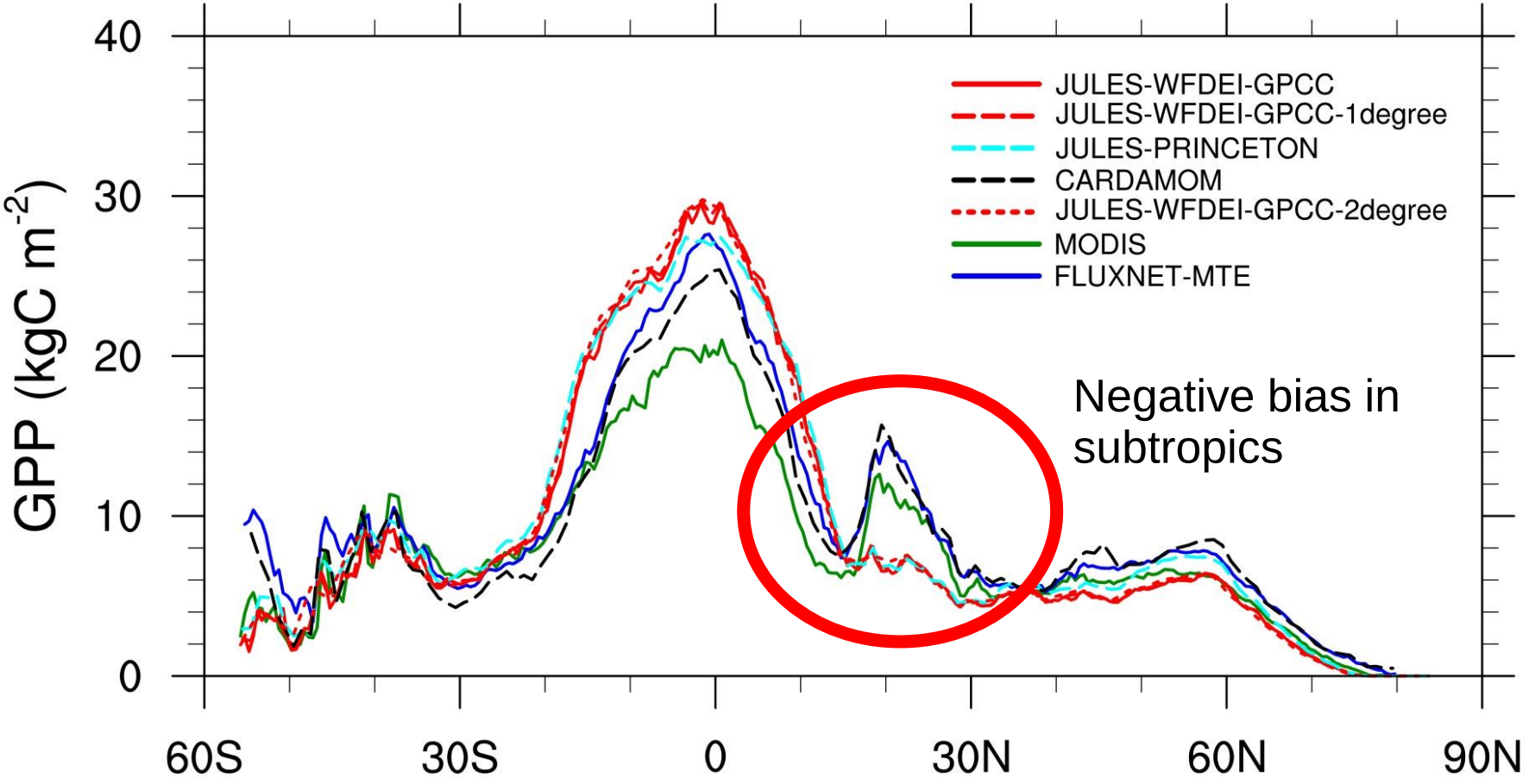
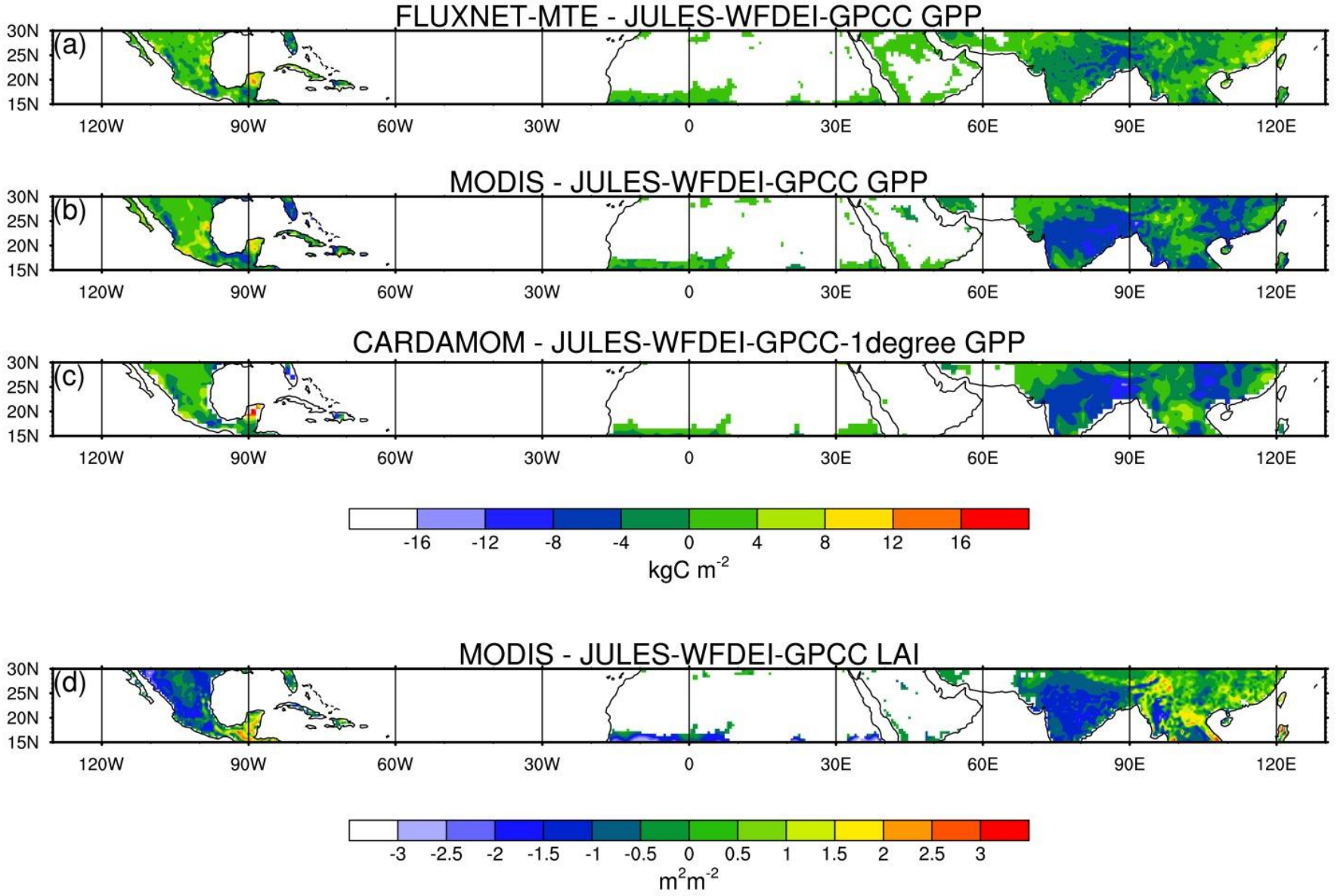


Sensitivity to spatial resolution & meteorological dataset



The **negative bias in JULES GPP in the subtropics** is due to low LAI simulated by the model compared to MODIS. MODIS LAI is used as input when generating the MODIS, FLUXNET-MTE and CARDAMOM GPP estimates.



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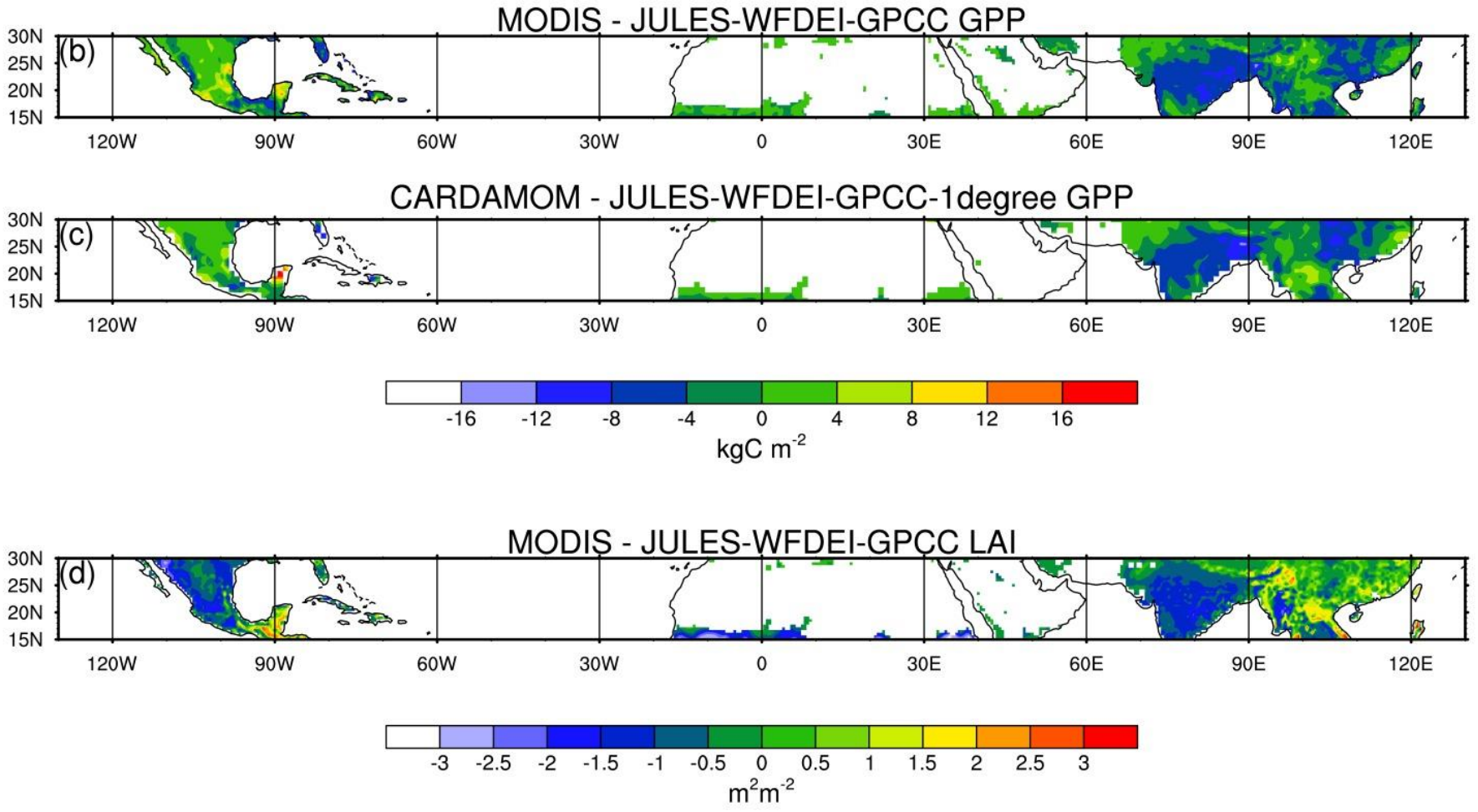
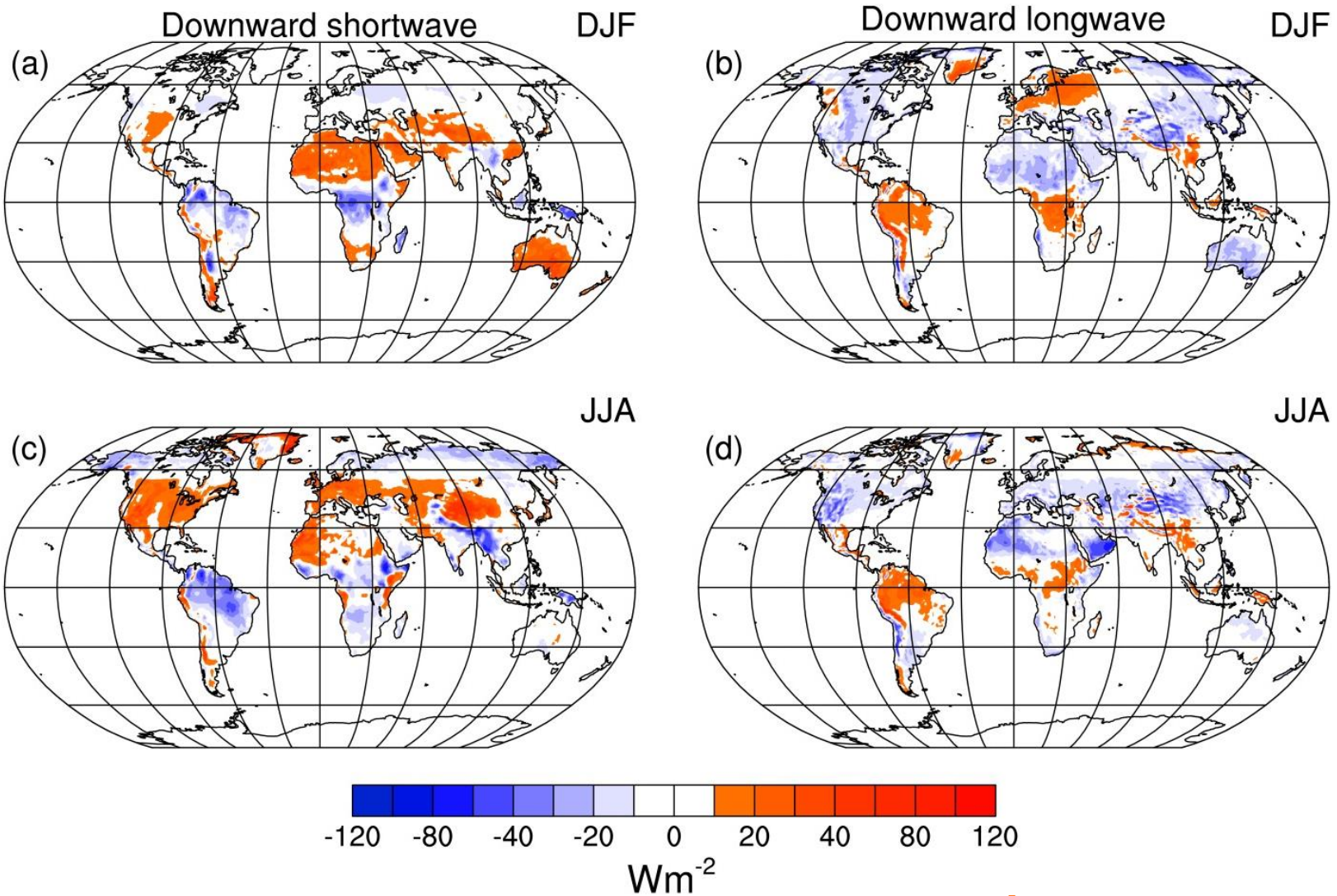
Negative bias in the subtropics could be improved with addition of drought-deciduous PFT to JULES.



Differences in meteorological dataset affects how photosynthesis is calculated



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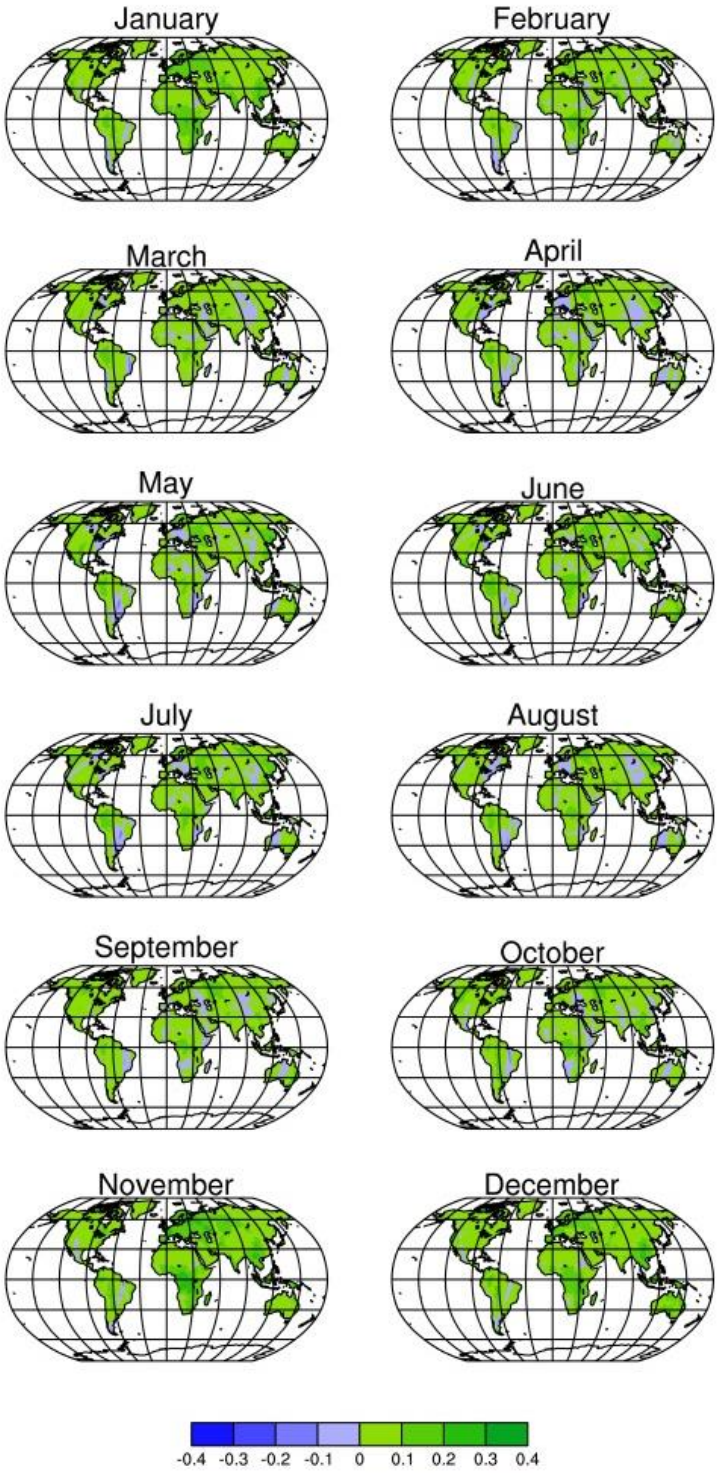
Since the WFDEI-GPCC dataset has lower downward SW radiation than PRINCETON, photosynthesis in the WFDEI-GPCC driven simulation was more light-limited.

Difference in monthly climatologies of light-limited model gridbox fractions (0-1) between the JULES-WFDEI-GPCC-1degree and JULES PRINCETON model simulations at global scales.

Photosynthesis in the WFDEI-GPCC driven simulation more light-limited than PRINCETON.
Green = WFDEI-GPCC simulation more light-limited than PRINCETON, blue = opposite



Datasets & further information

- JULES GPP dataset
  - http://dx.doi.org/10.7488/ds/1461
- Ancillary data
  - http://dx.doi.org/10.7488/ds/1995
- Manuscript
  - Accepted for publication in GMD.
- PhD thesis
  - http://hdl.handle.net/1842/18757